Pediatric Airway Management: Case Scenario

Pediatric Airway Management Basics Module II

ICEMA Continuing Education

Pediatric Airway Management Case Scenario-Module II

This module is intended to reinforce concepts introduced in Module I Pediatric Airway Management and introduce Continuous End Tidal CO2 (ETCO2) monitoring and capnography. If you have not completed Module I. Please do so *before* starting this module.

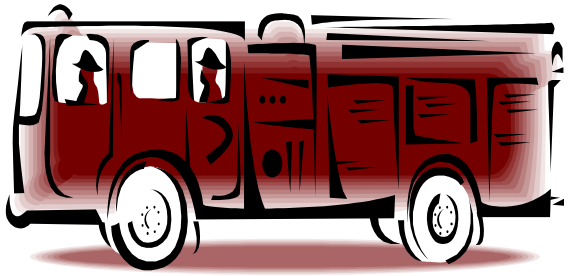
OBJECTIVES:

- By the end of this module participants will be able to:
  - State one or more reasons for NGT/OGT insertion
  - Describe two (2) tips to effective BVM ventilation
  - Indicate two (2) reasons for ET tube intubation
  - Describe two (2) methods of preventing dislodgement
  - Verbalize two (2) or more reasons why continuous ETCO2 monitoring is helpful
  - Identify four (4) different capnography waveforms and what they mean
  - Verbalize two (2) troubleshooting tips and tricks
  - State three (3) ePCR pediatric airway verification documentation points

CASE SCENARIO

First responder arrives on scene to a mother's screams and a man on the floor attempting to do CPR on what appears to be about an one (1) month old baby.

Upon initial assessment it is confirmed that the baby is limp, pulseless and apneic.



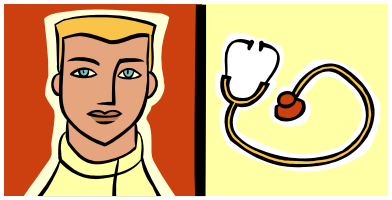
What's next?

- *Remain focused*
- *Take a deep breath*
- *Continue engaging the situation*

Heightened emotions due to a dying child can influence perceptions of time, demand & actions even for the experienced EMS provider.

Further assessment reveals:

- The person providing the bystander CPR is the mother's boyfriend.
- The baby had a "fever" last night.
- No other medical history, baby was born at 36 weeks gestation. Went home with no complications.
- Last bottle feed 3-4 hours ago.
- Mom woke up to check on the baby and noticed he was not breathing.
- Lungs are clear bilaterally, belly is soft, no visible signs of any other injury. Skins cool to touch.



What's next…

(…with the airway?)

- Insert OPA/NPA
- BVM with O_2

✓Do NOT dig your fingers into the jawline.

✓Don't lean forward and occlude the patients airway. Pull back those elbows.

Don't Forget…

- Squeeze the bag gently…
  - 2 fingers around the bag is generally all your will need.
- Don't rush!

For those of you who would like some additional instruction…Here is something funny to help you remember…

http://www.youtube.com/watch?feature=player_detailpage&v=Yh-oXXjgyJw

Copy and paste the link to your web browser. DOES NOT HYPERLINK!

Back to the scenario…

- Compressions and BVM with 100% O2 have been started.
- IO has been established and full PALS procedure is on the way.

Just then….

Just Then…

- Your baby's oral cavity fills with gastric secretions.
- Immediately:
  - You start to suction the oral cavity
  - Lose the ability to create a good seal around the nose and mouth with the mask

What happened?

What Happened?

- Air enters the stomach more easily than an adult. This will increase the risk of vomiting and aspiration of gastric contents.
- Air could have been forced into the stomach during bystander CPR as well…
- An infants diaphragm is thin and flexible. The stomach is more able to stretch the diaphragm and compress the lungs making it difficult to ventilate.

DON'T Forget…

To decompress the stomach.

- Always assume that there is food in the stomach and a potential for vomiting and aspiration

Insert a NGT or OGT.

#1 NO NGT or OGT

Notice the distended belly. The belly is pressing up into the lung cavity making ventilation efforts difficult.

#2 NGT or OGT INSERTED

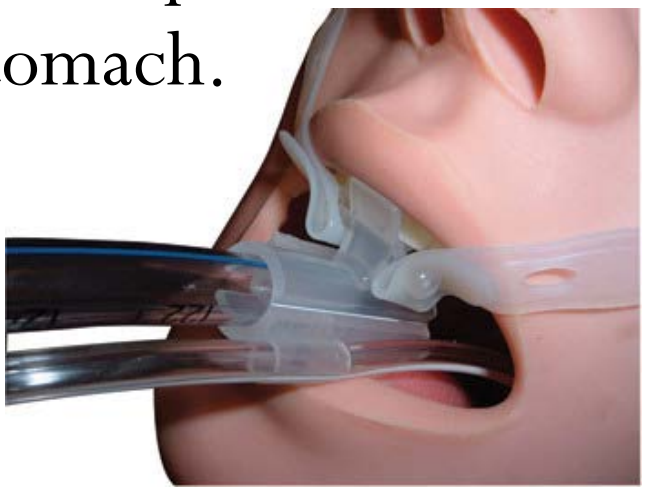
The belly is flat & soft . It will not impede ventilation efforts.

It is best to insert an NGT/OGT **before** intubation during the BVM phase.

Nasogastric tube (NGT) or Orogastric tube (OGT)?

- The preferred method is to place an orogastric tube (OGT) during BVM ventilation or after ET intubation in infants.
- However, both NGT or OGT are acceptable methods of decompressing the stomach.

- Yes, it is okay to intubate with the OGT in place.



To intubate or not to intubate?

Now, you have some help. More paramedics have arrived as well as a transport ambulance.

Should you intubate?

Things to consider…

- BVM is it working?
- Am I effectively ventilating my patient?
- Have I decompressed the stomach (NGT/OGT) ?
- Can I maintain good BVM ventilation?
- Is the closest hospital far away?

If BVM is working… Continue on!

- ✓ Continue to engage the situation.
- ✓ Assess and reassess the patient.
- ✓ Do not delay transport to a hospital.

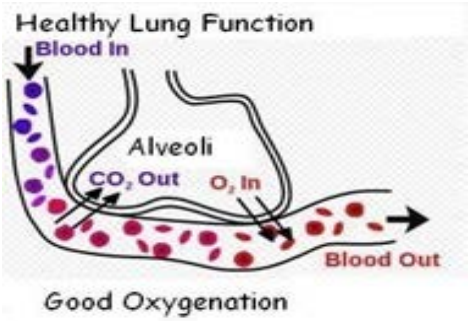
Ventilation vs. Oxygenation

Ventilation vs. Oxygenation

Breathe In…Breathe Out…

- This is the active, **mechanical** process of breathing.
- How we get rid of CO_2
- At the cellular level, O_2 & glucose combine to produce energy. CO_2 is the waste product.
- CO_2 is carried back through the blood & exhaled through the lungs via the aveoli.
- Capnography measures ventilation.

O_2…Did you get it into the body?



- How we get oxygen to the tissues.
- Gas exchange occurs at the capillary alveolar membrane.
- O_2 is transported to the tissues through the bloodstream.
- Pulse oximetry measures oxygen in the blood.

For more on Capnography/Capnometry!

How do you know that BVM is working?

Ventilation vs. Oxygenation

Breathe In…Breathe Out…

- Look for the rise & **fall** of the chest.

  Don't forget the *exhale*!
- Feel for lung compliance…Is it hard to "bag"?
- Don't RUSH!
  - Capnography waveform can help. Does it look normal?
  - Capnometry value between 35-40 mmHg?

O_2…Did you get it into the body?

- Pulse oximetry normal?

  Understand there is up to a 30 sec. delay in monitor feedback!!
- Skins signs good? No cyanosis?
- There is no singular method to assess oxygenation in the prehospital setting.
- **Look at the whole package!**

For more on Capnography/Capnometry!

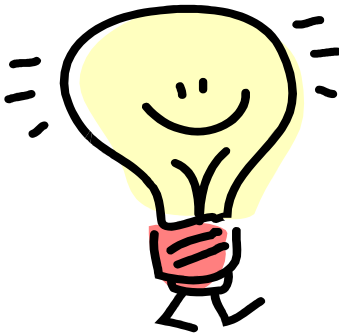
…You have made the decision to intubate this infant…

- A 3.5 uncuffed ETT is inserted.
  - ✓Visualized tube passing the vocal chords
  - ✓Mist is present in the tube
  - ✓Bilateral breath sounds present
  - ✓Symmetrical rise and fall of the chest
  - ✓Good Capnographic reading & waveform and/or
  - ✓Colorimetric ETCO2 shows good color change
- The tube is secured at the lip.
- Cervical spine alignment is maintained to prevent movement and dislodgement of the ETT.

- You **own** the ET tube!! Guard it! Hold on to it!

What else is missing??

Continuous $ETCO_2$ Monitoring



Here's a crash course…

What Is It?

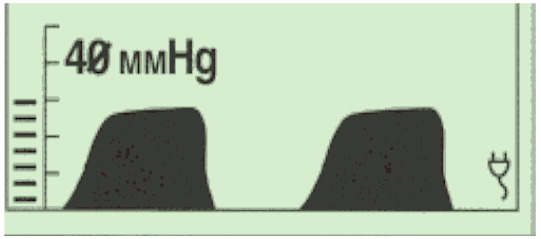
Measures CO_2 in an exhaled breath…

CAPNOMETRY

- Provides a numeric reading, an actual amount, of CO_2.

CAPNOGRAM

- In addition to the number - is also displayed as a waveform.

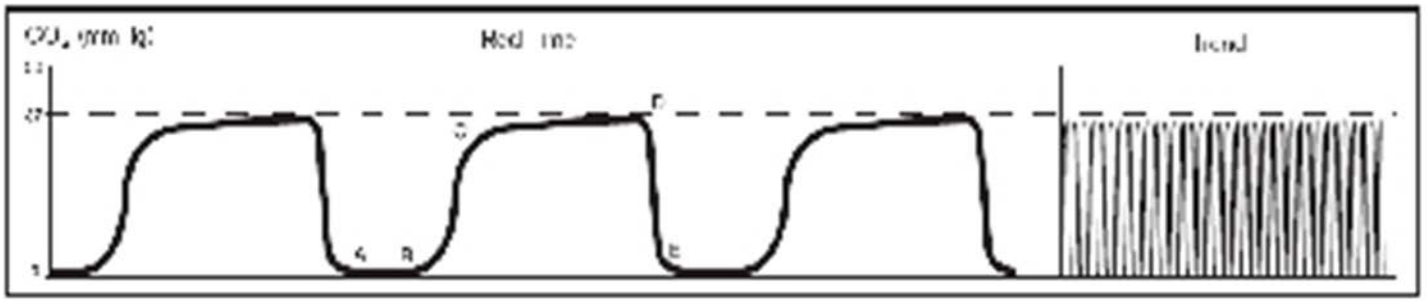


How can continuous ETCO2 monitoring using capnography help?

- Provides an EARLY warning sign of respiratory depression and apnea (much faster than a pulse oximeter)
- Presents objective information regarding respiratory effort & rate
- Helps to verify and *continuously* monitor ET tube placement
- Immediate detects and indicates ET tube dislodgement.

Also, capnography helps by…

- Determining the presence of bronchospasm.
- Loss of circulatory function.
- Determining adequacy of CPR compressions.
- Detecting ROSC.
- Predicting cardiac arrest .



Normal Capnogram

Provides an EARLY warning sign of respiratory depression and apnea …

What does that mean??

- As the respiratory rate decreases (or STOPS-eek!) the CO_2 level in the body increases.
- Conversely, if the respiratory rate increases the CO_2 level decreases.

CAPNOMETRY: provides a numerical value of the CO_2 level…close to real time.

Reassess the patient and interventions.

WAVEFORM CAPNOGRAPHY: provides a visual. Different waveforms mean different things…

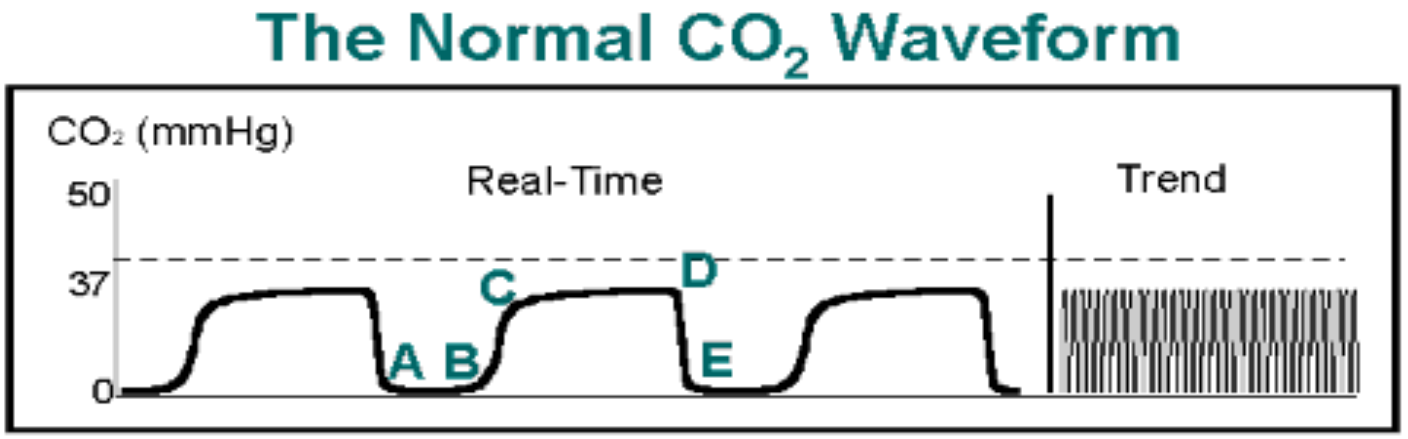
$ETCO_2$ Numerical Values-CAPNOMETRY

$ETCO_2$ numerical values are dependent on 3 variables:

- CO_2 production
- Delivery of blood to lungs & the lungs ability to exchange gas
- Alveolar ventilation

- **Normal** = 35-45mmHg
- **Hyperventilation** = < 35mmHg (Respiratory alkalosis)
- **Hypoventilation** = > 45mmHg (respiratory acidosis)

This is what a NORMAL CO_2 Waveform looks like…

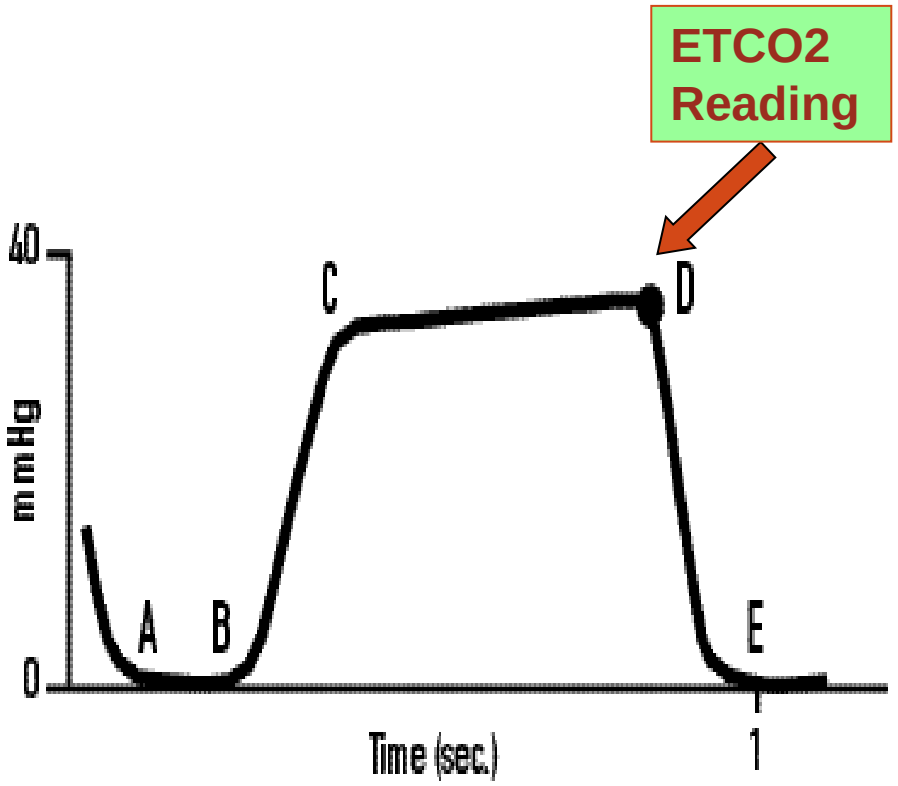


- A – B Baseline
- B – C Expiratory Upstroke
- C – D Expiratory Plateau
- D $ETCO_2$ value
- D – E Inspiration Begins

Image courtesy of novametrix®

Normal $ETCO_2$ Waveform

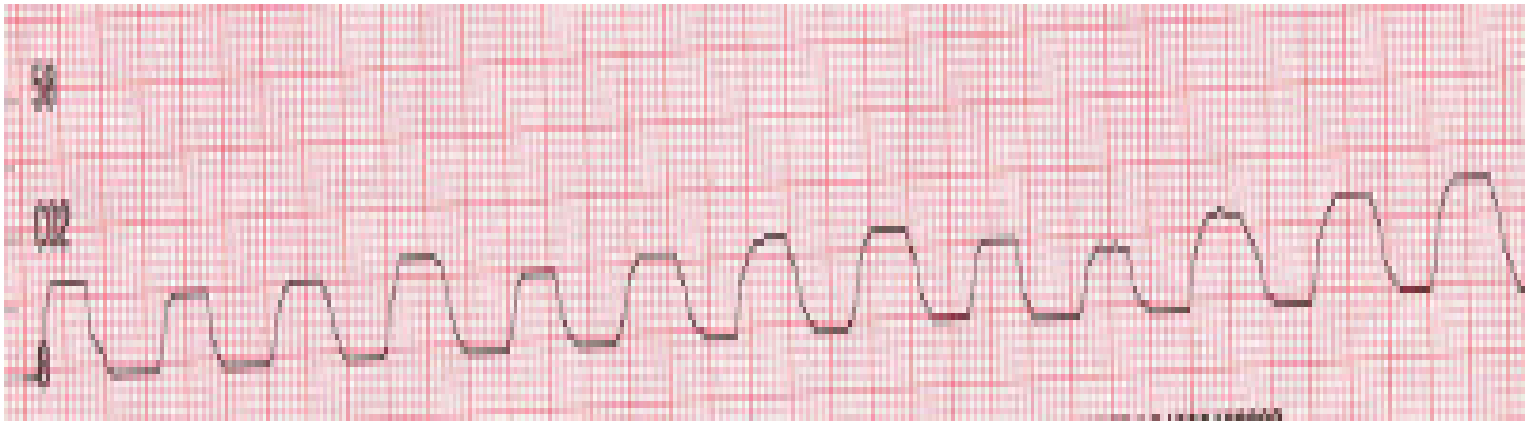
- Normal 35-45 mmHg
- Waveform reflects how close numerical value is to actual end tidal volume
- Square – GOOD 
- Round - BAD 



Now, back to the case scenario…

Oh no! Your baby's capnography wave form looks like **this**…

$ETCO_2$=24mmHg and rapidly dropping



What is it?

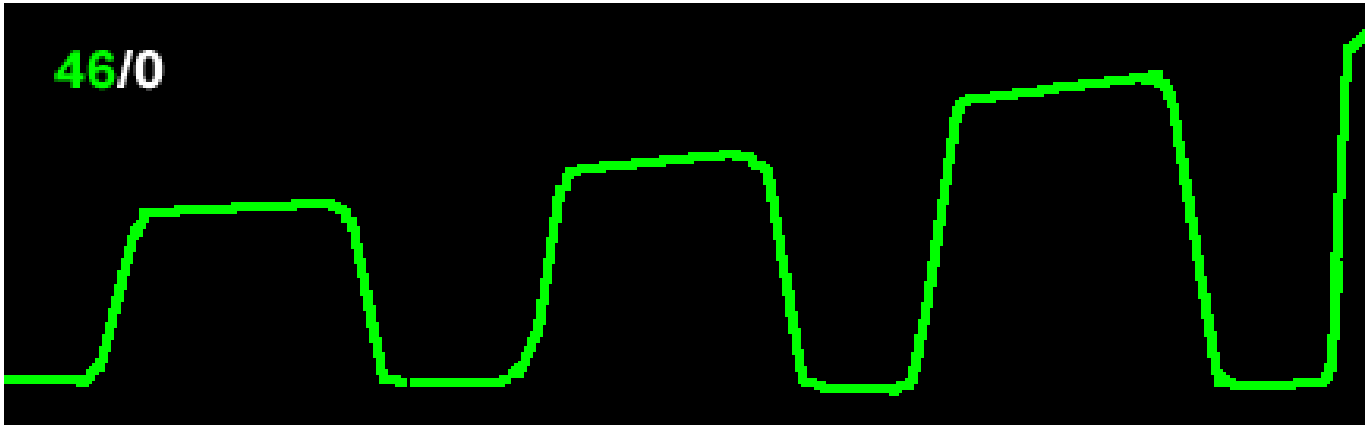
Hyperventilation…

caused by bagging too fast.

SLOW DOWN

Maintain capnometic value (ETCO2) of 35mmHg – 45mmHg

Uh Oh… now you see this!!



Hypoventilation

- Decreased rate with rising $ETCO_2$
- Slightly increase the rate of bagging. Do not over compensate and hyperventilate…

Image courtesy of novametrix®

Hyperventilation or Hypo ventilation may have some bad consequences…

HYPERVENTILATION

For example:

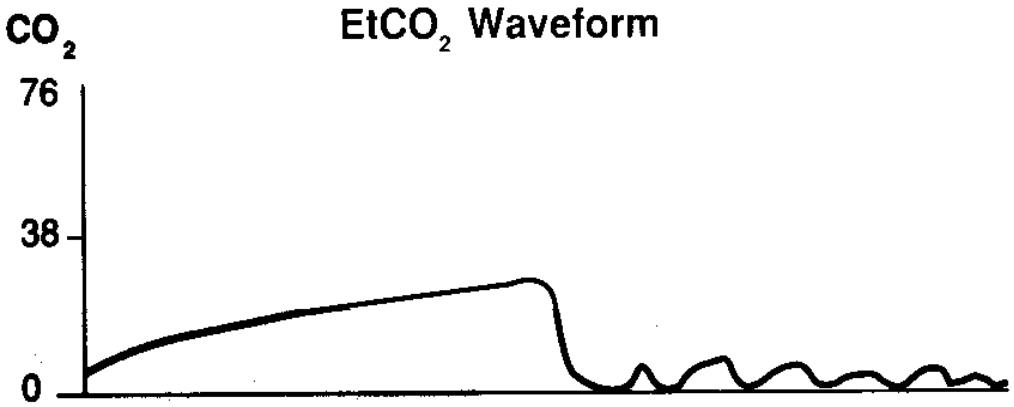
- Asthma patients *retain* CO_2, trying to ventilate them down to $EtCO_2$ 35 mmHg could cause a pneumothorax
- For Traumatic Brain Injury (TBI) patients: causes vasoconstriction, robbing the brain of much need oxygen and nutrients to an injured brain.

HYPO VENTILATION

For example:

- The patient ends up with hypoxemia.
- Doesn't have enough oxygen and nutrients circulating to the tissues.
- Builds up lactic acid.

And now the waveform looks like this…



What just happened?

Image courtesy of novametrix®

What is it?

ET tube dislodgement.

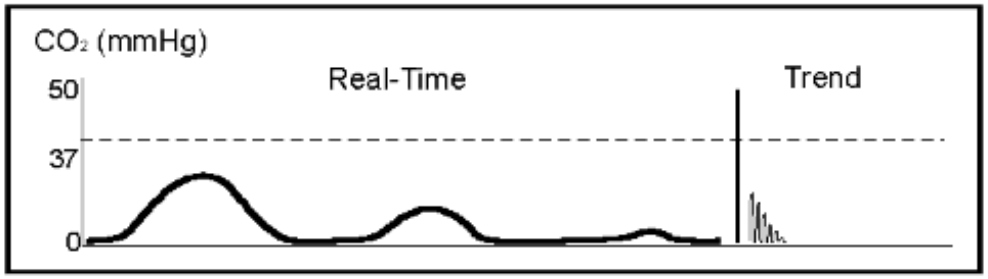
Most advance airway tubes are dislodged during patient movement:

- transfer from ambulance gurney to hospital gurney
- CPR
- application of cervical spinal immobilization
- taking an x-ray

Reassess tube placement before and after patient movement.

Esophageal Intubations can kill…This is what the waveform may look like:

Endotracheal Tube in Esophagus



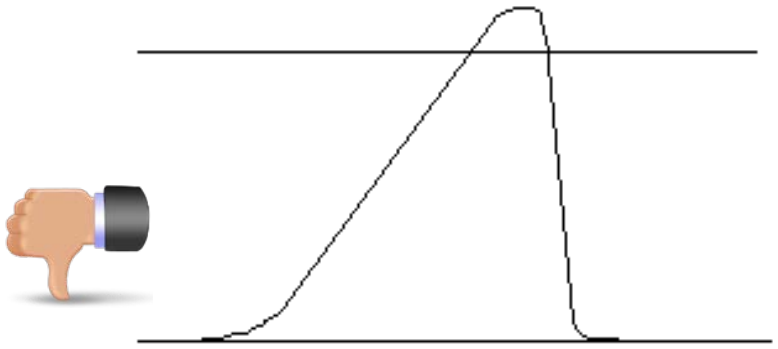
Possible Causes:

- Missed intubation
- A normal capnogram is the best evidence that the ET tube is correctly positioned
- With ET tube in the esophagus, little or no CO_2 is present

To continue to monitor the waveform capnography, in addition to the ECG , VS, **reassess tube placement**.

Image courtesy of novametrix®

The waveform on the monitor is now showing…



SHARK FIN WAVE FORM

Indicates:

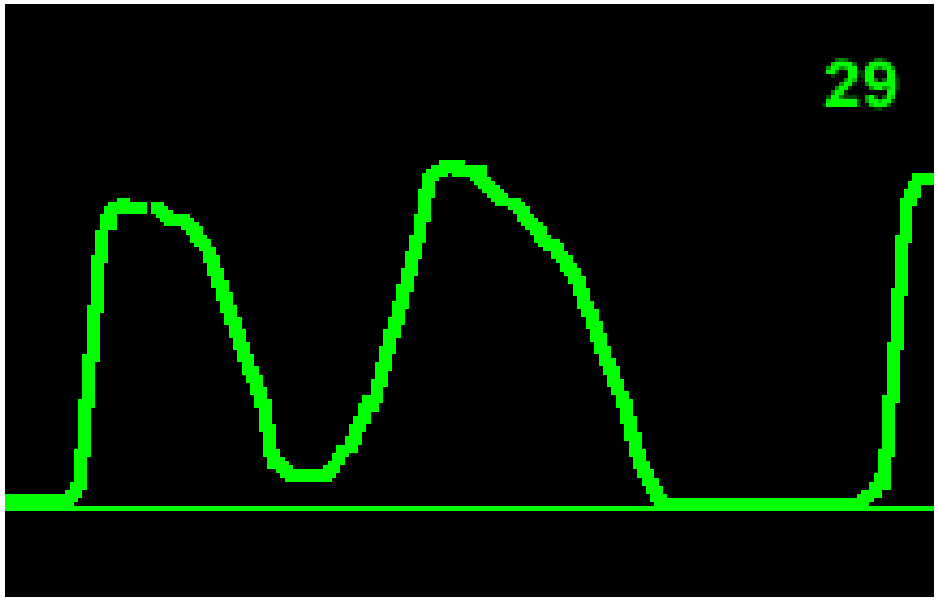
- Kinked tube
- Herniated cuff
- Bronchospasm Asthma, COPD
- Any obstruction that limits expiration

Reassess tube placement.

Image courtesy of novametrix®

What if the tube's in the right main stem bronchus?

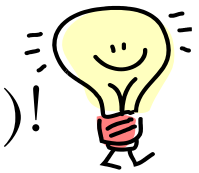
- Numerical Values and Waveforms may or may not change, but SaO_2 will be low, because O_2 is delivered to only one lung



Other Abnormal Waveforms

Absent alveolar plateau indicates incomplete alveolar emptying or loss of endotracheal airway integrity.

- ✓ Partial airway obstruction caused by secretions
- ✓ Endotracheal tube in the hypopharynx
- ✓ Leak in the airway system (**check connecters**)!



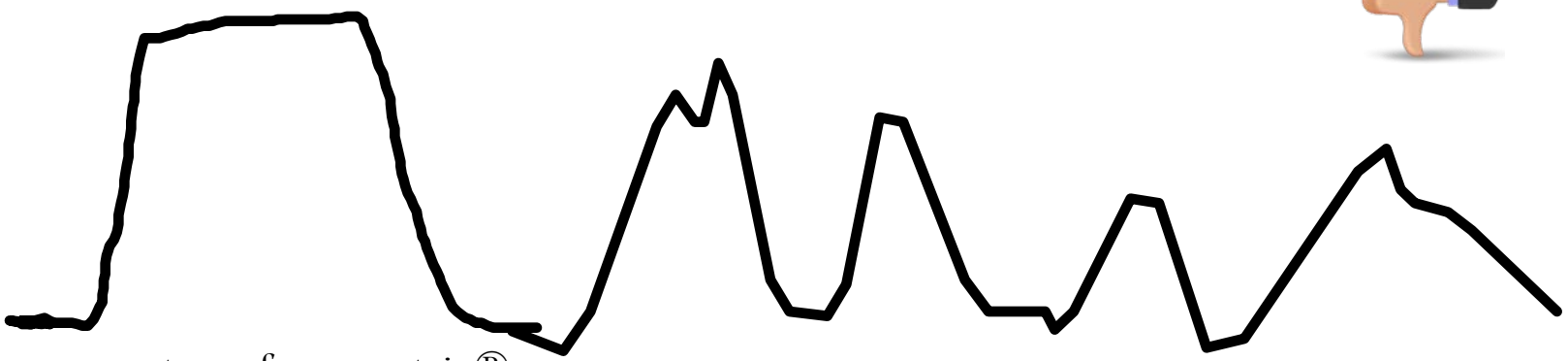


Image courtesy of novametrix®

TROUBLESHOOTING **TIPS** & TRICKS

- Symmetrical chest movement
- Auscultate for equal breath sounds
- Document absent breath sounds over stomach
- End-tidal carbon dioxide (required by new guidelines)
  - May be low if cardiac output low (especially in infants)

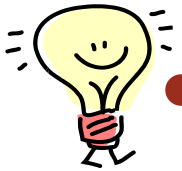
BE A "DOPE"

- Dislodged tube (tube at the carina?)
- Obstructed tube (kinked tube?)
- Pneumothorax
- Equipment failure

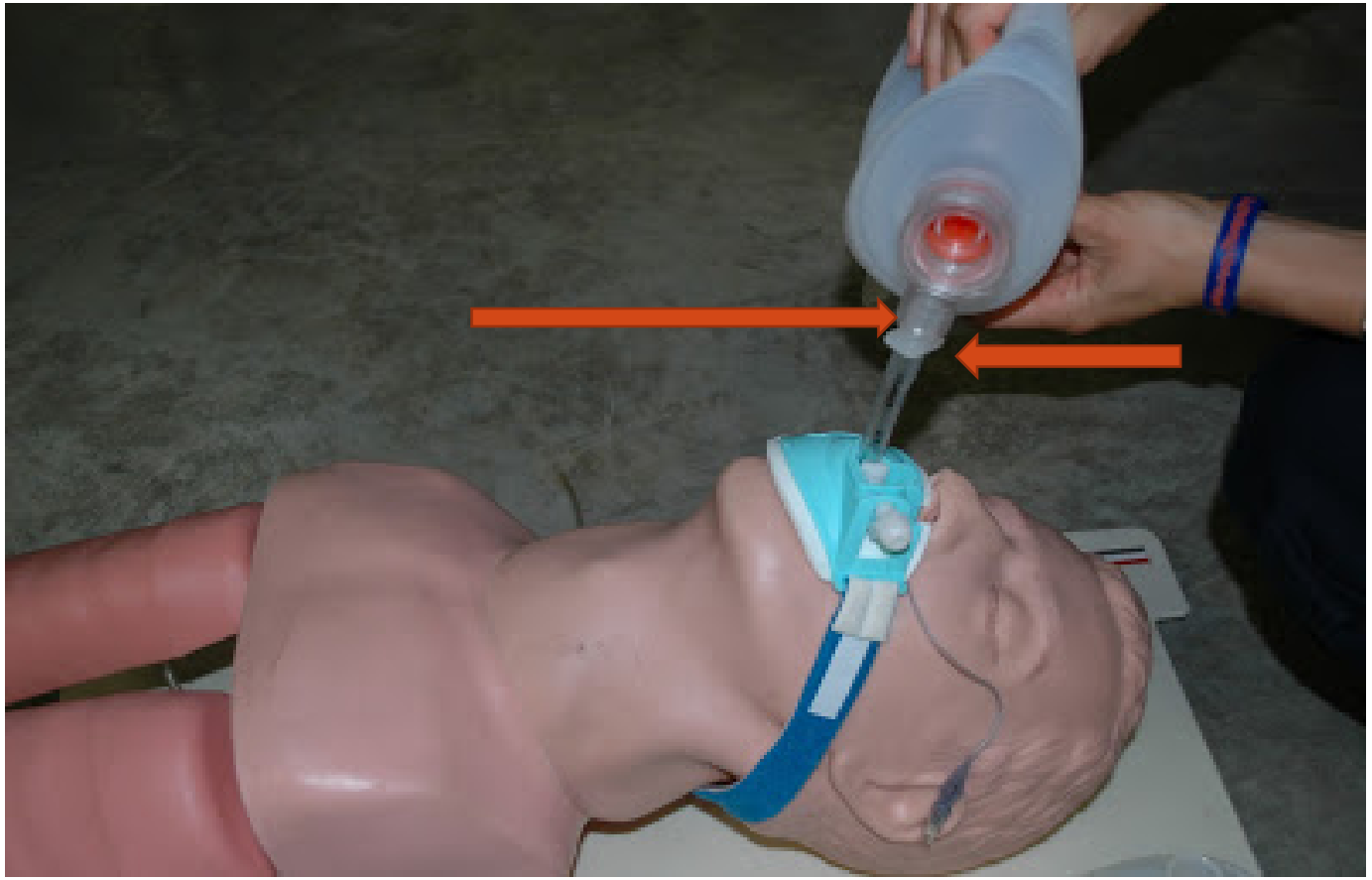
TROUBLESHOOTING TIPS & TRICKS

- If you're getting a value of = 0
  - Remove detection device from ETT and BLOW into it.
    - Does it give a reading? Is there CO_2?
  - Verify tube placement
    - Breath sounds? Epigastric sounds?
    - Go to colorimetric sensor
- Document ETT problems!
- This is not a race.
- No excuse for not troubleshooting.

TROUBLESHOOTING TIPS & TRICKS



- Check connectors!
- Common disconnection points=



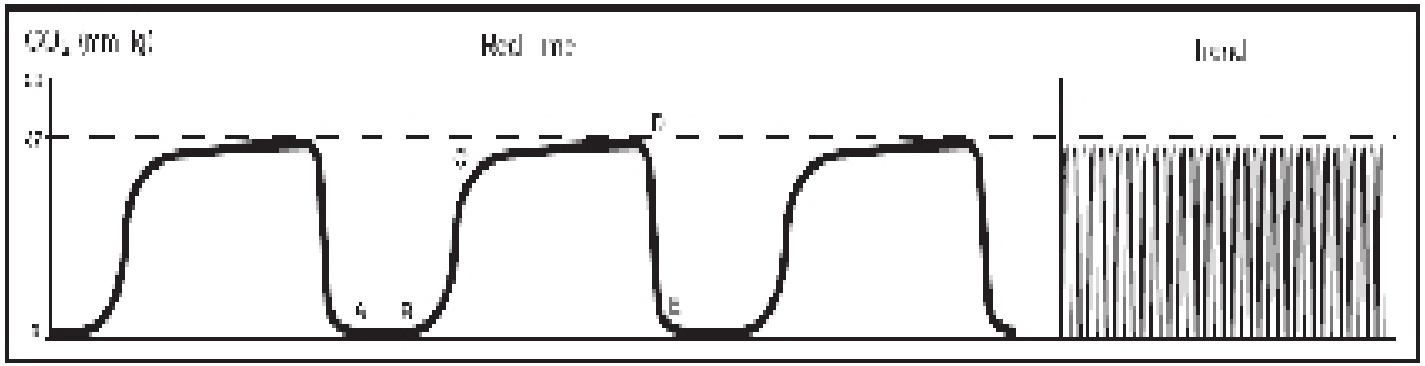
TROUBLESHOOTING TIPS & TRICKS

- Zero may be a legitimate reading.
- If in doubt… PULL IT OUT!

  - NEVER DELIVER A QUESTIONABLE TUBE.
  - Slow down and fix the problem.
  - IT'S NOT A RACE

Phew... (back to the case scenario)

- You have arrived to the emergency department.
- The ET tube has <u>not</u> dislodged during the transport and transfer to the ED gurney.
- You've diligently reassessed the ***patient***, VS's, monitor & documented.
- The waveform looks like this:



Normal Capnogram

Phew... (back to the case scenario)

- The ED MD confirms placement through direct visualization and later with an X-ray. There are no complications
- The Pediatric Airway Verification section of the ePCR is completed with the physician's signature and documentation of the placement, complications and method of verification.
- A copy of the capnograpy monitor strip is downloaded or scanned into the ePCR system.

Re-cap:

The EMS providers did a great job maintaining the airway & ventilating the patient by:

- Suctioning oral secretions
- Decompressing the stomach before intubation using a NGT/OGT while ventilating via BVM
- Once intubated:

  - Securing the ET tube
  - Cervical spine immobilization
  - Holding onto the ET tube-OWNED IT!!
  - Continuous assessment re-assessment of the **patient**, VS, ECG
  - Continuous monitoring of capnometry/capnography & intervening appropriately to values less than 35mmHg
  - Continuous reassessment of tube placement

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GREAT JOB!!

THANK YOU to Dr. VanStralen, Susie Moss & Bill Jones for your expertise and contributions to this module.